Introduction

The following note is written to satisfy the requirements of Mechanical Lifting in a High-Consequence/High-Value Lift (as described in LBNL Pub. 3000 chapters 5.4.5.3 and 5.4.7 section 3). The replacement cost of the Spallation Neutron Source (SNS) Medium Energy Beam Transport (MEBT) is estimated to be $5 M. Damage to this assembly would have a significant impact on the schedule of the project.

Item : MEBT (approximately 9000 lb.)

Lifting Equipment (below hook): Caldwell Model 27 F – Four Point Lifting Beam SN 30597 (610 lb.)

Total Hook Load: ~ 9,610 lb.

Center of Gravity: Approximate center of gravity of entire MEBT assembly

X= 33.4” (From front of side beam of Support Frame)

Y= 32.2” (From the bottom of the base beam)

Z= 68.7” (From the edge of the side beam (RFQ side)

See figure 1 below.

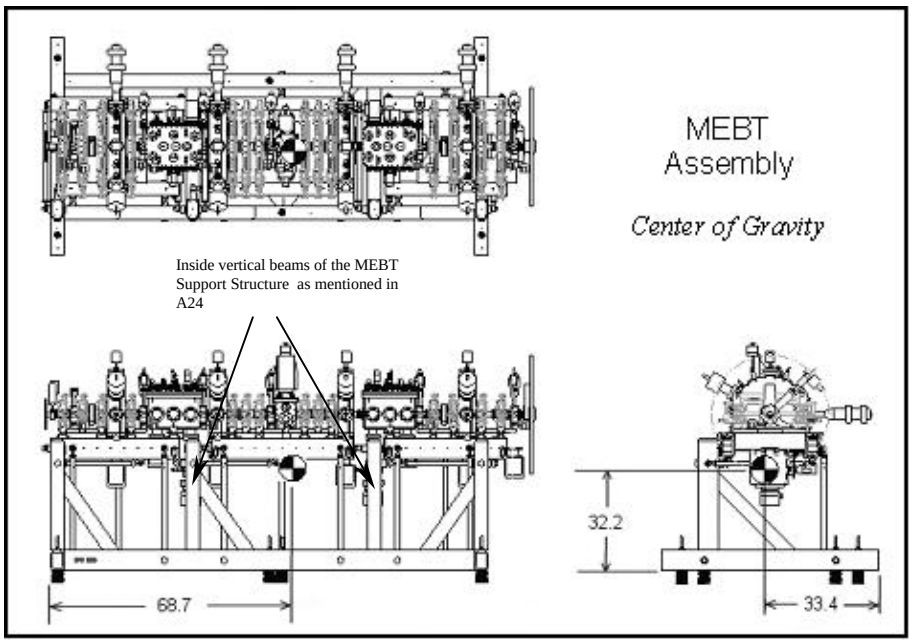

Figure 1 Diagram of approximate center of gravity of the MEBT equipment.

Identification of Personal (sign and date)

Each person involved in a high-consequence/high-value lift must be familiar with this procedure before beginning work.
A pre-lift meeting with all participating personnel must be held before the lift. All participating personnel must initial this procedure sign-off sheet to verify that they are familiar with the procedure.

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Required Lifting Equipment

4 each, Safety hoist ring, 3/4-10 thread, for attachment to each corner of the Support Frame, 5,000 pound capacity. Each must be able to carry 1/4 of the load (2250 pounds each). The additional capacity is needed in case of an over turn accident where two of the rings will carry the entire load.

4 each, Safety shackles, minimum 5/8 shackle size, for attachment to each Support Frame corner hoist ring of the, 5,000 pound capacity. Each must be able to carry 1/4 of the load (2250 pounds each). The additional capacity is needed in case of an over turn accident where two of the shackles will carry the entire load.

4 each, Slings for connecting the hoist rings to the lifting beam, 6-8 feet long, and 5,000 pound minimum capacity. Each must be able to carry 1/4 of the load, which is 2250 pounds. The additional capacity is needed in case of an over turn accident where two of the slings will carry the entire load.

1 each, 5 ton four point lifting beam. 11 feet long with two 5-foot adjustable spreaders. Must be able to carry the full load of the assembly, which is approximately 9,000 pounds, in the configuration shown below. This is a commercially purchased item.

2 each, Safety hoist ring, 1/2-13 thread, to connect slings to the top of the vertical beams to prevent over turning.

4 each, Sling connecting a 1/2" safety hoist ring to the hook to prevent over turning. Will have a minimum possible length to prevent over turning motion. Length to be determined at lifting time. Each must have a 5000 pound minimum capacity. This rigging is not intended to carry any load except in an overturn incident and each sling must be able to carry half of the full load (4,500 pounds) of the assembly.

2 each, Raft safety plates required to stabilize the load. This rigging is not intended to carry any load except in an overturn incident and each must be able to carry one quarter of the full load (2250 pounds) of the assembly.

4 each, Hand crane hoists as required to stabilize the load. Each must have a 4000 pound minimum capacity. This rigging is not intended to carry any load except in an overturn incident and each sling must be able to carry one quarter of the full load (2250 pounds) of the assembly.

8 each, 20 foot long tether ropes.

1-each, Crane weigher-dynamometer.

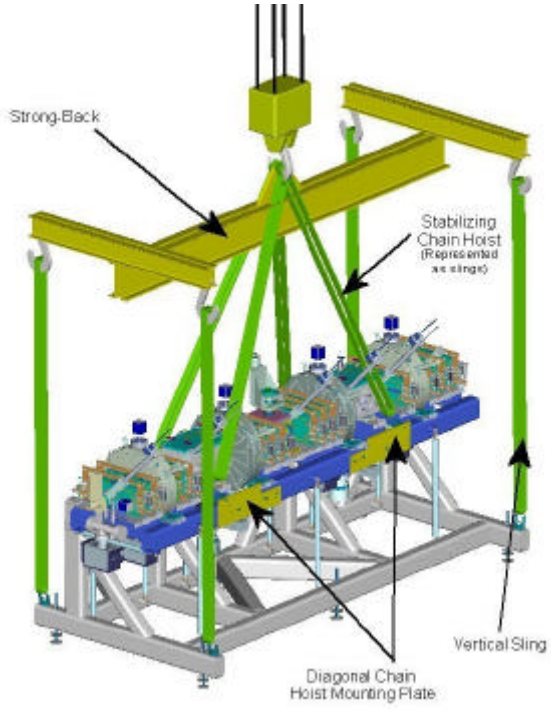
Preliminary Procedures

The lifting and moving of the MEBT is scheduled for Wednesday June 12, 2002. A rigging pre-lift review must take place before the MEBT is lifted.

On June 10th the riggers will test lift the MEBT to determine the final positioning of the lifting hardware (in terms of the center of gravity). Before any lifting is done the MEBT will be weighed with four scales (one at each corner) to determine the center of gravity (CG). Once the MEBT is on the 4 scales the frame will be lifted at a central point opposite two of the scale to be sure the load is on only two scales. The weights will be noted. The same procedure will be used on the other side and two more weights will be recorded. From these four weights we will determine where the C.G. is located. If the CG is not directly under the hook we will add the appropriate amount of additional weight to move it directly under the hook.

Additionally the riggers will lift the MEBT with a dynamometer on the crane hook to determine the total shipping weight of the assembly. These activities will help to determine the best approach for safely lifting and moving the MEBT with enough time before the actual lift to alter equipment or manufacture any additional hardware.

Sign off of the following Step Wise procedure by the Person in Charge (PIC) is necessary for the preliminary lifting and the actual move. The PIC must check off for completion of each item on checklist. Be sure all lifting equipment is properly tagged with a proof load tag.



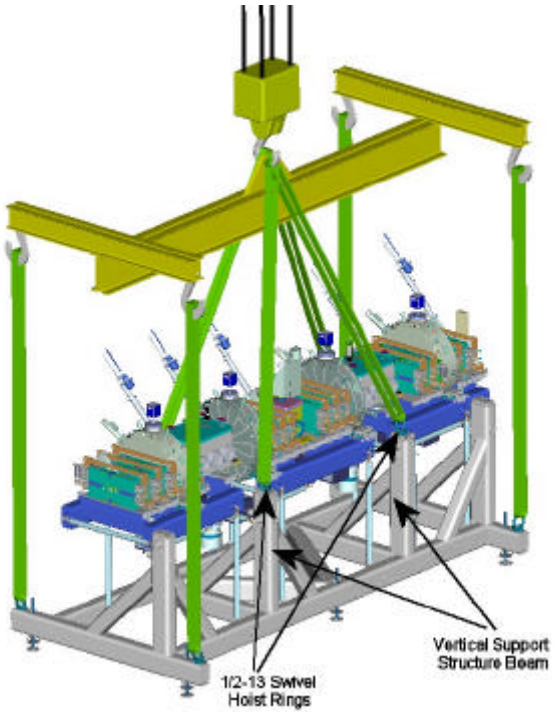


Figure 2 MEBT Rigging Labels

Step Wise Procedures

A. Verify the center of gravity and weight of the MEBT

C.G. and weight Preliminary Operations checklist:

✍✍ **A1)** Disconnect the bellows between the rafts of the MEBT.

✍✍ **A2)** Disconnect the bellows between the MEBT and the RFQ.

✍✍ **A3)** Disconnect the waterlines between the MEBT and the RFQ.

✍✍ **A4)** Disconnect the waterlines between the MEBT and the wall.

✍✍ **A5)** Disconnect /remove the power cables to the quadrupoles of the MEBT, all diagnostic and control cables from the MEBT that terminate in the racks and all RF cables from the MEBT that terminate in the racks.

✍✍ **A6)** Disconnect the nitrogen, air, etc. lines between the MEBT and the RFQ.

✍✍ **A7)** Disconnect the nitrogen, air, etc. lines between the MEBT and the wall.

✍✍ **A8)** Disconnect /remove the gray 6" wireway between the MEBT and the RFQ.

✍✍ **A9)** Disconnect /remove the ladder trays to the MEBT.

✍✍ **A10)** Move rafts apart (in z-direction) to create approximately a ½" gap between rafts.

✍✍ **A11)** Remove the 12" and the 6" wire way from the MEBT uni-strut frame.

✍✍ **A12)** Remove any other MEBT items which may interfere with the rigging equipment.

✍✍ **A13)** Replace the quadrupole covers.

✍✍ **A14)** Remove the roughing pumps (turbo-pumps).

✍✍ **A15)** Unbolt the MEBT support structure from the floor.

✍✍ **A16)** Make certain that any added weight added to the assembly is secure.

✍✍ **A17)** Make certain that all disconnected cables and hoses of the assembly is secure.

C.G. and weight Primary Operations:

✍✍ **A18)** Place the two short safety slings (to provide for a chain hoist) onto the building 71 gantry crane hook.

✍✍ **A19)** Place the "dynamometer" on the crane hook.

✍✍ **A20)** Place the strong-back/spreader onto the dynamometer hook.

✍✍ **A21)** Place the two hand crane hoists onto the (short) safety slings.

✍✍ **A22)** Place the remaining 2 safety slings onto the building 71 gantry crane hook.

✍✍ **A23)** Bolt one of the four 3/4-10 heavy duty hoist rings to each corner of the MEBT Support Structure and torque the bolts to 100 ft-lb.

✍✍ **A24)** Bolt one of the two raft safety plates to MEBT Rafts #1 and #3 using 3/8-16 bolts torqued to 12 ft-lb (see figure 2).

✍✍ **A25)** Bolt one of the four 1/2-13 heavy duty hoist rings to the top of each of the 2 inside vertical beams of the MEBT Support Structure and the two raft safety plates. Torque the bolts of the heavy duty hoist rings to 28 ft-lb.

✍✍ **A26)** Attach the safety shackles to the hoist rings.

✍✍ **A27)** Move the crane hook/"dynamometer" plus strong-back/spreader combination over the MEBT.

✍✍ **A28)** Connect the all slings and hand chain hoists to the safety shackles (see figure 2 below). The 4 chain hoists are **NECCESSARY** and **REQUIRED** for a safe stable lift.

✍✍ **A29)** Remove any equipment that may be in the path of the sling from hoist ring to strong-back/spreader hooks.

✍✍ **A30)** Re-check all rigging to prevent any pressure points or snags with the MEBT equipment.

✍✍ **A31)** Slowly lift the MEBT making sure that all 4 vertical slings are free to tighten without catching or pushing on any of the MEBT equipment. The diagonal slings should be tightened enough to stabilize the load.

✍✍ **A32)** With the 4 vertical slings carrying all of the load adjust the diagonal chain hoists until the MEBT is level and stable.

C.G. and weight Primary Operations (cont.):

✍✍ **A33)** Slowly lift the MEBT just high enough to determine an accurate center of gravity (i.e. stability of the load with no tendency to roll).

✍✍ **A34)** Note the total weight of the MEBT/Strong-back assembly and write it in here: _____

✍✍ **A35)** Slowly lower the MEBT back to the floor.

✍✍ **A36)** Adjust rigging if necessary and repeat the test lift (to achieve maximum stability).

✍✍ **A37)** When done with the test lifting remove the slings from the MEBT.

✍✍ **A38)** Move crane hook/"dynamometer" plus strong-back/spreader combination away from the MEBT.

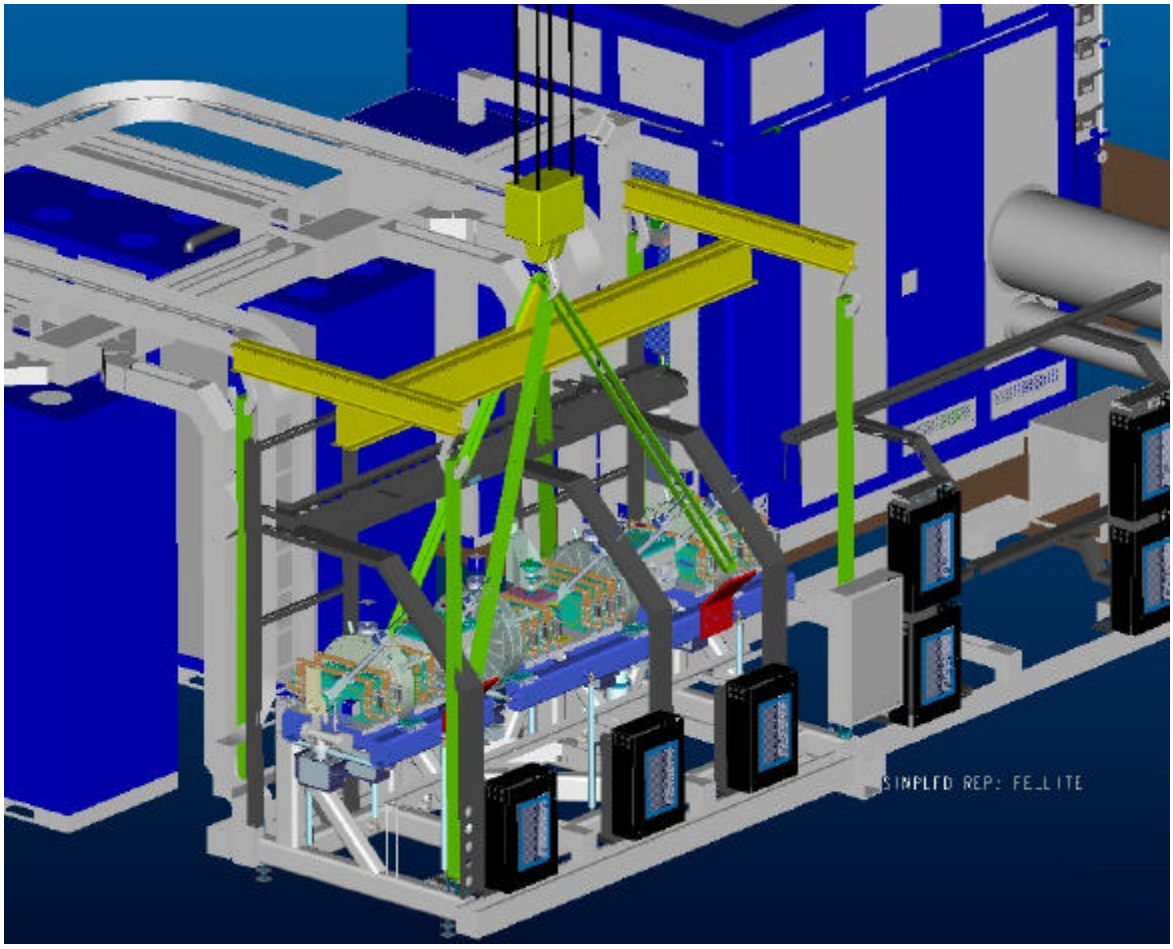
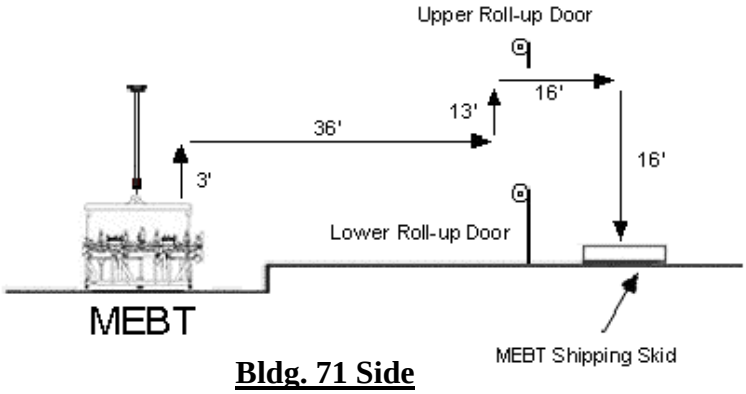


Figure 3 Pro/E model showing the crane hook, strong-back, lifting slings and the MEBT ready for lifting. The diagonal slings are for visualization purposes and will be replaced by hand chain hoists during the actual lift. Additionally the red diagonal chain hoist mounting plates will be as shown in figure 2.

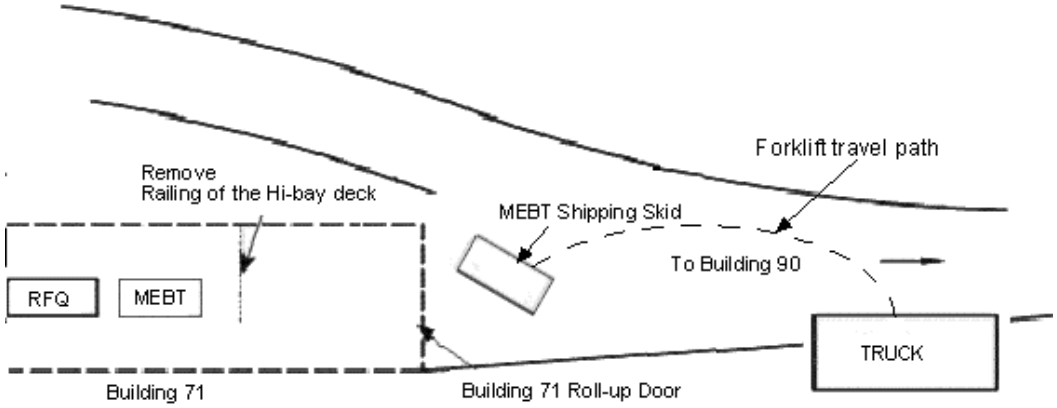
Load Path

The load path for the lifting/handling operation shall occur in building 71. The MEBT assembly will be moved by crane from its position on the main floor of the SNS – FES beamline area to just outside of the roll-up door at the west end of the building. The MEBT must first be lifted high enough to clear the upper deck (approximately 3 feet). The MEBT must travel approximately 36 feet west toward the rear door. The MEBT must then be lifted high enough to clear the upper deck of the lower roll-up door (approximately 13 feet above the floor) at the rear of building 71's Hi-bay. It will be taken over the lower roll-up door and outside. Once outside of building 71 the MEBT assembly will be slowly lowered to within 18 inches of the ground. The MEBT will be rotated to the appropriate angle and slowly lower into place on a shipping skid that will be pre-positioned outside of the roll-up door. Lifting in Building 71 will be done with the building overhead gantry crane, which is rated at 20,000 pounds. The crane shall be operated at its slowest travel speed to help prevent an overturn accident should a sudden stop occur. The MEBT assembly will be lifted and moved with all support and alignment hardware in place in the same configuration as for the operating condition.

The following diagrams in figure 3 below show the load path in building 71.



Bldg. 71 Side



Bldg. 71 Top

Figure 4 Diagram of the MEBT load path for crane motion from beamline to shipping skid.

B. Lift / Move the MEBT and load on truck

MEBT Lift / Move Preliminary Operations checklist:

✍✍ **B1)** Disconnect the bellows between the rafts of the MEBT.

✍✍ **B2)** Disconnect the bellows between the MEBT and the RFQ.

✍✍ **B3)** Disconnect the waterlines between the MEBT and the RFQ.

✍✍ **B4)** Disconnect the waterlines between the MEBT and the wall.

✍✍ **B5)** Disconnect /remove the power cables to the quadrupoles of the MEBT, all diagnostic and control cables from the MEBT that terminate in the racks and all RF cables from the MEBT that terminate in the racks.

✍✍ **B6)** Disconnect the nitrogen, air, etc. lines between the MEBT and the RFQ.

✍✍ **B7)** Disconnect the nitrogen, air, etc. lines between the MEBT and the wall.

✍✍ **B8)** Disconnect /remove the gray 6" wireway between the MEBT and the RFQ

✍✍ **B9)** Disconnect /remove the ladder trays to the MEBT.

✍✍ **B10)** Move rafts apart (in z-direction) to create approximately a ½" gap between rafts.

✍✍ **B11)** Remove the 12" and the 6" wire way from the MEBT uni-strut frame.

✍✍ **B12)** Remove any other MEBT items which may interfere with the rigging equipment.

✍✍ **B13)** Replace the quadrupole covers.

✍✍ **B14)** Remove the roughing pumps (turbo-pumps).

✍✍ **B15)** Unbolt the MEBT support structure from the floor.

✍✍ **B16)** Make certain that any added weight added to the assembly to move the C.G. is secure.

✍✍ **B17)** Make certain that all disconnected cables and hoses of the assembly is secure.

✍✍ **B18)** Remove the upper deck railing.

✍✍ **B19)** Clear the load path of any obstruction that might interfere with the move.

✍✍ **B20)** Pre-position the MEBT shipping skid outside at the west end of the Hi-bay of building 71 (just beyond the roll-up door and before the end of the crane's travel).

MEBT Lift / Move Preliminary Operations checklist (cont.):

✍✍ **B21)** Level the MEBT shipping skid as necessary.

✍✍ **B22)** Drape four of the 20 foot ropes over the lower roll-up door wall at the west end of Bldg. 71.

✍✍ **B23)** Place the two (short to provide for a chain hoist?) safety slings onto the building 71 gantry crane hook.

✍✍ **B24)** Place the strong-back/spreader onto the crane hook

✍✍ **B25)** Place the two hand crane hoists onto the (short) safety slings.

✍✍ **B26)** Place the remaining 2 safety slings onto the building 71 gantry crane hook.

✍✍ **B27)** Bolt one of the four 3/4-10 heavy duty hoist rings to each corner of the MEBT Support Structure and torque the bolts to 100 ft-lb.

✍✍ **B28)** Bolt one of the two raft shipping plates to MEBT Rafts #1 and #3 using 3/8-16 bolts torqued to 12 ft-lb (see figure 2).

✍✍ **B29)** Bolt one of the four 1/2-13 heavy duty hoist rings to the top of each of the 2 inside vertical beams of the MEBT Support Structure and the two raft safety plates. Torque the bolts of the heavy duty hoist rings to 28 ft-lb.

✍✍ **B30)** Attach the safety shackles to the hoist rings.

✍✍ **B31)** Move the crane hook plus strong-back/spreader combination over the MEBT.

✍✍ **B32)** Connect the all slings and hand chain hoists to the safety shackles (see figure 2 below). The 4 chain hoists are **NECCESSARY** and **REQUIRED** for a safe stable lift.

✍✍ **B33)** Remove any equipment that may be in the path of the sling from hoist ring to strong-back/spreader hooks.

✍✍ **B34)** Re-check all rigging to prevent any pressure points or snags with the MEBT equipment.

✍✍ **B35)** Position two people with radio communication equipment (e.g. walkie-talkies) at both the area of the lifted equipment and at the main power cutoff switch in case of any problem with the crane (e.g. crane runaway).

MEBT Lift / Move Preliminary Operations checklist (cont.):

✍✍ **B36)** Position a person on the upper railed deck of building 71 to watch and indicate when the MEBT will clear of the upper deck of the roll-up door.

✍✍ **B37)** Attach 4 of the 20 foot ropes, one to each corner of the MEBT, to guide the load.

✍✍ **B38)** Position 4 people one at each corner of the MEBT controlling the tethers

✍✍ **B39)** Slowly lift the MEBT making sure that all 4 vertical slings are free to tighten without catching or pushing on any of the MEBT equipment. The diagonal slings should be tightened enough to stabilize the load.

✍✍ **B40)** With the 4 vertical slings carrying all of the load adjust the diagonal chain hoists until the MEBT is level and stable.

✍✍ **B41)** Slowly lift the MEBT just high enough to determine an accurate center of gravity.

✍✍ **B42)** Slowly lower the MEBT back to the floor.

✍✍ **B43)** Adjust rigging if necessary and repeat the test lift.

✍✍ **B44)** Block all traffic on Chamberlain Road.

MEBT Lift / Move Primary Operations checklist:

✍✍ **B45)** Lift the MEBT high enough (approximately 3 feet) to clear the upper deck at the rear of the beamline area of Building 71.

✍✍ **B46)** Slowly move the MEBT west to the rollup door at the rear of building 71.(see figure 3 above).

✍✍ **B47)** STOP all western travel of the crane 5 feet in front of the roll-up door

✍✍ **B48)** Tie the 4 ropes draped over the wall to the tether leads at each corner of the MEBT.

✍✍ **B49)** Position the two leading people controlling the tethers outside the roll-up.

✍✍ **B50)** Pull the two leading ropes draped over the wall until the tether is reached.

✍✍ **B51)** Lift the MEBT high enough (approximately 13 feet) to clear the upper deck of the bottom roll-up door at the rear of the Hi-bay area of Building 71.

MEBT Lift / Move Primary Operations checklist (cont.):

✍✍ **B52)** Slowly continue move the MEBT west over the lower rollup door and out the rear of building 71 (see figure 3 above).

✍✍ **B53)** STOP all western travel of the crane after the MEBT has cleared the roll-up door.

✍✍ **B54)** Pull the two trailing ropes draped over the wall until the tether is reached.

✍✍ **B55)** Slowly lower the MEBT until it is slightly above the ground.

✍✍ **B56)** Slowly position the MEBT until it is slightly above the pre-positioned shipping skid.

✍✍ **B57)** Slowly lower the MEBT into the pre-positioned shipping skid.

✍✍ **B58)** Remove the slings from the MEBT.

✍✍ **B59)** Move crane hook plus strong-back/spreader combination away from the MEBT.

MEBT Forklift Move Primary Operations checklist:

✍✍ **B60)** Secure the MEBT assembly to the shipping skid.

✍✍ **B61)** Align **the 15 ton forklift** with shipping skid.

✍✍ **B62)** Slowly move forklift forward to position the forks under the shipping skid.

✍✍ **B63)** Attach one end a security strap or come-along to each side of the MEBT assembly and attach it to the fork lift to prevent sideways motion of the MEBT.

✍✍ **B64)** Slowly lift the MEBT slightly off the ground and re-check the stability of the load.

✍✍ **B65)** Move the MEBT to the side loading curtain truck.

✍✍ **B66)** Position the MEBT to align it with its final position on the truck.

✍✍ **B67)** Raise the MEBT until the bottom of the skid is slightly above the bed of the truck.

✍✍ **B68)** Move the MEBT into the truck until the assembly is in its final shipping position.

✍✍ **B69)** Slowly lower the MEBT onto the truck bed until all weight is off of the forks.

✍✍ **B70)** Back the forklift away from the curtain truck and lower the forks to the ground.